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Opinion Dynamics in Gendered Social Networks: An Examination of Female Engagement Teams in Afghanistan

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Abstract. International forces in Afghanistan have experienced difficulties in developing constructive engagements with the Afghan population, an experience familiar to a wide range of international agencies working in underdeveloped and developing nations around the world. Recently, forces have begun deploying Female Engagement Teams, female military units who engage directly with women in occupied communities, resulting in more positive relationships with those communities as a whole. In this paper, we explore the hypothesis that the structure of community-based social networks strongly contributes to the effectiveness of the Female Engagement Team strategy, specifically considering gender-based differences in network community structure. We find that the ability to address both female and male network components provides a superior ability to affect opinions in the network, and can provide an effective means of counteracting influences from opposition forces.

1 Introduction

Success in Afghanistan depends on developing an understanding of, and avoiding a hostile reaction from, the communities that comprise the Afghan population: failure to do so has resulted in fractionalization and destabilization several times in the history of the region [1]. Despite realization of the importance of community engagement, U.S. attempts to effect regional stabilization through local community interventions have met with, at best, mixed success [2].

In 2009, the United States and coalition forces initiated the deployment of Female Engagement Teams (FETs) [3]. Derived from the military employment of females to conduct personal searches of female civilians in Iraq (dubbed Lioness teams) [4], FETs are composed of female military personnel who expand the Lioness mission to include humanitarian engagement and provision of medical care [3].

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Although anecdotal accounts exist regarding the successful operations of FETs, as yet there exists no study of the theoretical foundations that might account for the successes. In this investigation, we employ an opinion dynamics model on idealized social networks characterized by strong gender assortativity to analyze how gendered networks contribute to opinion formation, and how FETs and other groups might act to influence opinions and behaviors in those networks. A successful model would allow the investigation of elements that determine whether a given community might respond well to an FET-based intervention strategy, would allow for the generalization of engagement strategies based on gendered and otherwise highly assortative networks outside the immediate context of Afghanistan, and would permit the application of those principles in contexts other than counter-insurgency operations.

Our focus includes modeling how opinions related to international forces evolve in a community, and how extra-community agents (including FETs, traditional male-only engagement teams, and local opposition forces), interacting with gendered networks, can influence opinions in the community.

2 Origin of Structure in Gendered Social Networks

The topologies that characterize social networks emerge from the relationships between and among individuals [5]. The kinds of relationships that contribute to individual studies can vary widely. Social networks have been investigated in a wide variety of contexts, including corporations [6], schools [7], and electronically mediated communities, such as Internet sites [8].

In addition to enabling and mediating relationships among individuals, social contexts can act to constrain the kinds of relationships available. These constraints can originate implicitly, determined by existing community characteristics. For example, if two individuals are unlikely to encounter one another in a social context, they are unlikely to form a relationship [9]. Communities that constrain interactions between individ-

uals of different classes can thus exhibit segregation within their social networks.

In addition, individuals tend to form friendships with friends of their friends. This property, called transitive closure, can act to increase the density of ties in social cliques by forming triangles (connected triads) of individuals [10]. It has also been observed that individuals tend to form relationships with people who resemble themselves according to some sets of socio-demographic characteristics, including ethnicity, age, class, and gender [11]. This may be due to the contributions of proximity and contact frequency, or due to opinion propagation of affective evaluations, as described in structural balance theory [12].

Gender assortativity, the tendency for like-gendered individuals to form relationships, has been observed in many types of networks, including childhood and elementary schools [13] and secondary schools [10] in the United States, in workplaces and entrepreneurial endeavors [14, 15], and in immigrant populations [16].

Gender can also influence the qualities associated with relationships within social networks. An examination of the National Longitudinal Study of Adolescent Health ("Add Health") data set indicated that the social relationships formed by female adolescents were more likely to result in triadic closures than those established by males [10].

Some studies have found that gender differences in perceived relationship intimacy exist, generally characterizing female relationships as more often incorporating mutual emotional support and male relationships as more often incorporating shared activities and instrumental support [18]. Cross-cultural studies have identified possible interacting roles for both biological explanations and socialization constraints [19]. Female-female social relationships in non-human primates have also been studied, and have supported the hypothesis that both ecological/environmental and biological factors influence gender-specific characteristics of social interactions [20].

3 The Existence of Gendered Networks in Afghan Communities

Sociological and anthropological studies of Afghan communities indicate several common factors relevant to this study. Afghanistan is multi-ethnic and multi-linguistic, with Pashtun and Tajik ethnicities and Afghan Persian and Pashto languages in the majority, and is almost exclusively Islamic, with 80% of the population being Sunni and 19% of the population being Shia [21].

Especially among the Pashtun, the conceptualization of tribal values of honor and shame lead to the general seclusion of women as a class both through the employment of a full veil and through walled family compounds [22]. In a 2002 study of female narratives in Afghanistan, one participant observed that she "talk[s] to every woman, and some men who are relatives" [23]. The strong limitations of interaction between the sexes are collectively termed *purdah*, and are generally common (with cultural variations) in many conservative Islamic societies and throughout South Asia [24].

Although women in Afghanistan are often seen as subservient and in some contexts are considered to be property [22], some researchers studying the region have cautioned against the dismissal of women as a powerful and influential force in the community, citing mother-son and wife-husband relationships, as well as relationships among the women themselves [3, 4, 25].

Women interact with each other in extended households and in labor contexts [25]. Solidarity among women plays an important role and can mark a counterpoint to the patriarchal culture that outwardly characterizes Afghan society [26, 25]. This dynamic has the potential to create strong social ties among women in Afghan communities, although rivalries can exist both within and between households.

Men in Pashtun culture hold significantly to a warrior-oriented value system, endorsing individual-oriented bravery and, in principle, a largely egalitarian social structure [22]. The concept of *Pashtunwali* defines a set

of core values of freedom, honor, revenge, and chivalry [27]. Conflict resolution is multi-level, with familial components (in the person of the father or grandfather), and local, regional/tribal, and national *jirgas*, or egalitarian authoritative bodies [28]. These individualistic concepts of honor and familial loyalties translate, in this model, to generally lower levels of affective association and opinion propagation between males than between females, resulting in relatively sparser networks of intimate relationships and influence.

4 The Opinion Dynamics Model

The bounded confidence opinion dynamics model used in this study is an extension of a model initially proposed to study the diffusion of environmental agricultural practices among European producers [29]. It is one of several related techniques derived from statistical physics Ising spin models [30].

The Deffuant-Weisbuch (DW) approach used here incorporates a community of individuals who have opinions modeled on the range [0,1]. Each individual is then potentially influenced by the people with whom she interacts, subject to the constraints of bounded confidence, according to the discrete time equation:

$$x_i(t+1) = x_i(t) + \frac{1}{|S_i|}\sum_{j \in S_i} \mu_{ij}[x_j(t) - x_i(t)] \quad (1)$$

where $x_i(t+1)$ is the opinion of the ith individual at the next time step, $x_i(t)$ is the current opinion of the ith individual, S_i is the set of neighbors of the ith individual and $|S_i|$ is the cardinality of the set, μ_{ij} is the plasticity value between the ith individual and her jth neighbor, and $x_j(t)$ is the opinion value of her jth neighbor. When applied to a directed social network, S_i consists of the out-degree neighbors of ith individual, and μ_{ij} is a weighting value characterizing the relative strength of the relationship between i and j with respect to i's opinion formation about the subject, and is analogous to an edge weight in a social network. This averaging approach is distinct from that employed in the original DW model, and is similar to that proposed by Hegselmann and Krause [31]. This approach

is also similar in its theoretical basis to that proposed by DeGroot [32] and used extensively in modeling consensus formation in economics and political science.

Application of the opinion update function in Equation 1 is subject to the constraints of bounded confidence:

$$|x_i(t) - x_j(t)| < \varepsilon_i \tag{2}$$

where $x_i(t)$ and $x_j(t)$ are as described above, $|x_i(t) - x_j(t)|$ is the absolute value of the difference in opinion values between the ith individual and her jth neighbor, and ε_i is the tolerance value, or confidence bound, of the ith individual. The tolerance value further restricts the individuals with whom the ith individual interacts to those that hold an opinion already "close enough" to the opinion held by i. This value represents the tendency of individuals to reject opinions seen as being too different from the ones they currently hold.

Opinion dynamics models can be seen as algorithmic realizations of structural balance theory as proposed by Cartwright and Harary [12] in which individuals having a positive relationship with each other will tend to develop over time the same opinion toward a third individual or idea. A related model proposed by French described how different patterns of influence between individuals connected by directed relationships could be seen to affect opinion formation [33]. In these two models, social power, affective ties, and attempts to minimize cognitive dissonance result in individuals altering their opinions to achieve a level of agreement with their neighbors in social space. Additional supporting research came from the seminal work of Asch, which demonstrated that perceived social pressure could influence test subjects to alter their answers to simple questions of observation [34].

5 Network Structures

One topic of current interest in social network research is the elicitation of community structure from network topological data. In this restricted sense of the term, a community within a social network can be broadly

defined as a group of individuals who have more connections to each other than they have to other individuals or groups [35].

We construct the graph for a social network representing an Afghan community by generating two independent graphs with a uniform probability of vertex connection, based on the class of random graphs proposed by Erdos and Renyi [36]. These algorithms generate graphs with a Poisson distribution of vertex degree, creating a graph whose vertices exhibit an average level of connectivity that then characterizes the network. These networks exhibit the formation of a single, giant connected component around the phase transition point $P = \frac{\ln(N)}{N}$ where P is the probability of a connection existing between any two given nodes, and N is the number of nodes in the network [36]. We generate the networks representing females and males separately, with a higher P value for the female network representing the greater degree of relationships exhibited by females in these communities. We then create links between the male and female networks, representing the relationships within households between husbands and wives, and mothers and sons.

In our opinion dynamics model, networks represent patterns of social influence relative to a specific idea or set of ideas, rather than simple definitions of categorical relationships, such as friendships or family ties. Idealized graph topologies, including the Poisson distribution generating topologies of Erdos and Renyi [36], the small world networks of Watts and Strogatz [37], and the power law networks of Barabasi and Albert [38], are approximations of real world networks capturing some aspects of certain types of relationships. For this study, the Poisson distribution networks were selected to approximate the idealized egalitarian structure of Pashtun community and tribal organizations [39].

6 Experimental Results

This analysis considers the ability of units including Female Engagement Teams to influence opinions in a population by examining average opinion values in the male and female communities under various scenarios.

In this model, opinion is used to measure the opinion about international forces, with higher opinion values indicating a higher opinion about international forces. A lower opinion is considered to indicate more support for opposition forces.

We simulate an Afghan community using a highly abstracted network model. The communities consist of random networks of 50 females and 50 males. In keeping with the sociological literature cited above, more female-to-female links exist in the community than male-to-male links (as illustrated in Figure 1). Initial opinions are assigned to community members following a truncated normal distribution centered at 0.5. The OD algorithm is allowed to run to equilibrium on the network, resulting in clusters of nodes in the community sharing similar opinions, and potentially differing sharply from other individuals in the community.

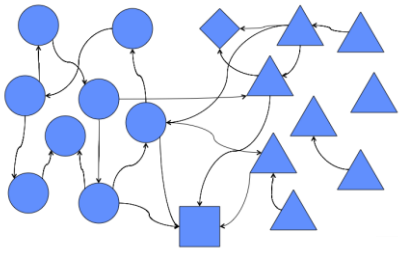

Fig. 1. Notional illustration of sample network topology. Circles represent females; triangles represent males; square represents FET; diamond represents opposition influence. Note the higher density of edges among females, the connections between the FET and both gender-based subnetworks, and the male-only connections of the opposition influence.

We model the effect of outside influences by introducing interventions in which an actor (allied FET or opposition group) introduces an opinion into a subset of the community (Table 1). The community social network is allowed to return to equilibrium and the mean population opinion values indicate the effectiveness of the intervention. The results shown in Table 1 represent the mean of 1,000 simulations over stochastically derived social networks.

Table 1 Community Opinions Resulting from Interventions

Intervention				Mean Results		
Code	**Actors**	**Population**	**Opinion**	**Female**	**Male**	**All**
NONE	N/A	N/A	N/A	0.500	0.500	0.500
FEM	FET	FEMALE	0.7	0.640	0.584	0.613
MALE	FET	MALE	0.7	0.532	0.556	0.544
MIX	FET	ALL	0.7	0.615	0.585	0.600
OPPO	OPPO	MALE	0.3	0.480	0.441	0.451
FEMOPPO	OPPO / FET	MALE/FEMALE	0.3/0.7	0.617	0.517	0.567
MIXOPPO	OPPO / FET	MALE/ALL	0.3/0.7	0.583	0.519	0.551
MALEOPPO	OPPO / FET	MALE/MALE	0.3/0.7	0.497	0.499	0.498

Experimental results support the hypothesis that FETs, by extending contact to the female community in a population, can bring about a greater shift in opinion than engagement teams who interact with the male community alone (Figure 2). In addition, units which include FETs can shift the opinions of populations in a favorable direction despite the influence of opposition forces due to the opposition's inability to successfully engage the female community. Under this model, simultaneous engagement of female and male communities (MIX) provides very good performance. Engaging either the female or the male networks singly (FEM or MALE) also provides an improvement over non-engagement (NONE). FET engagements are capable of counteracting opposition influences in communities (Table 1 and Figure 2). Importantly, FET's interacting with female population (FEMOPPO) or with an integrated population (MIXOPPO) are significantly more effective at countering opposition influence than an allied team interacting with an exclusively male population (MALEOPPO) at a 95% confidence level.

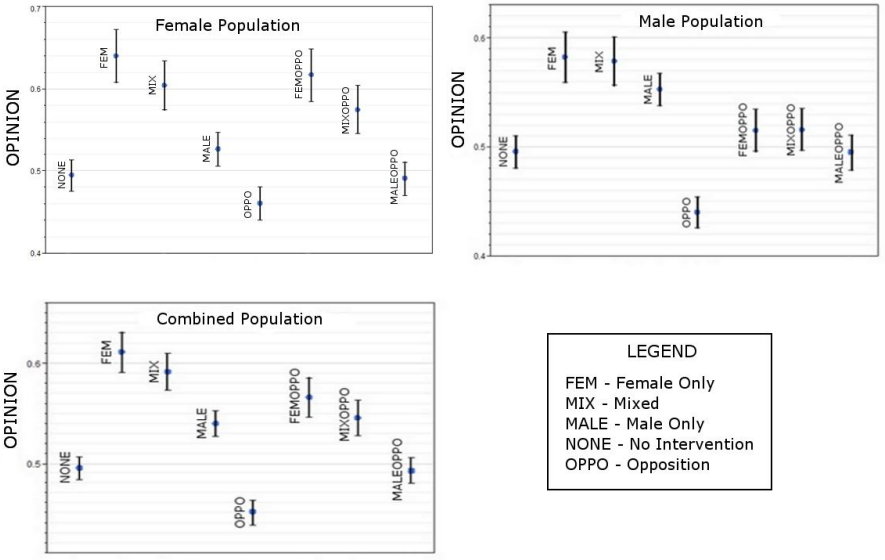

Fig. 2. Effect of Interventions on Community Opinions. Data points represent the mean opinion value of each population obtained from 100 stochastic simulation runs. The error bars represent 95% CI of the mean.

7 Discussion

Female Engagement Teams can significantly enhance the ability of international forces to effect changes in opinion in populations that exhibit strong assortativity in gender with associated community structure in the resulting social network. By engaging with both male and female populations in a given community, FETs allow for more efficient dissemination of information and opinions.

Opposition forces, if compelled by social rules to engage only the male population in a given community, can still significantly affect community opinion in the absence of counter-messaging by international forces. However, by engaging both male and female community members, FETs provide an effective countermeasure. Our modeling indicates that FETs acting on female and male social networks with topologies consistent with the literature can generate positive opinion shifts, which agrees with anecdotal accounts from units in the field.

These results were obtained using a simplified model with a highly aggregated opinion value. Real world opinions are more complex, and can consist of many different sets of concepts. In addition, this study considered a limited subset of network topologies. Future investigations should expand the number of topologies investigated, including scale-free networks and networks with more complex community structures within the gendered subdivisions. Future investigations should also introduce more complex structures representing individual opinions and behavioral decisions.

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